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NOTES ON THE FISH FAUNA OF GORGONA ISLAND (LIGURIAN SEA, NORTH-WESTERN MEDITERRANEAN)

INTRODUCTION – The fish fauna is commonly indicated as one of the most important taxa by which can be evaluated the "reserve effects" within more or less strictly protected areas (BELL, 1983; GARCIA-RUBIES & ZABALA, 1990; FRANCOUR, 1991).

The marine areas subjected to any kind of conservation or restrictive measures are, therefore, of particular interest for the assessment of protection effects.

This can be considered the case of Gorgona Island, whose surrounding marine environment is poorly known, although some information is available about the benthic flora (SARTONI & BODDI, 1992; PARDI *et al.*, 1993; PAPI *et al.*, 1995; CINELLI *et al.*, 1995). This is fundamentally due to the presence of a penitentiary since the last century which limited, in general, the access and fishery along the coasts of the island, but also, consequently, the scientific investigations.

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Such a situation can provide interesting information about the "reserve effects" on the fish fauna on very long term period, allowing the evaluation of the lack of decreasing diversity and abundance determined by overfishing, human pressure and habitat alteration in comparison with other areas of the North-Western Mediterranean.

In this work are reported the data collected at Gorgona Island in the frame of a programme carried out by ICRAM to order of "Ministero di Grazia e Giustizia".

The aim of the present study is to provide a first contribution to the knowledge of the fish fauna of Gorgona Island, considering that this area is included in the plan for the establishment of the marine park of the Tuscan Archipelago.

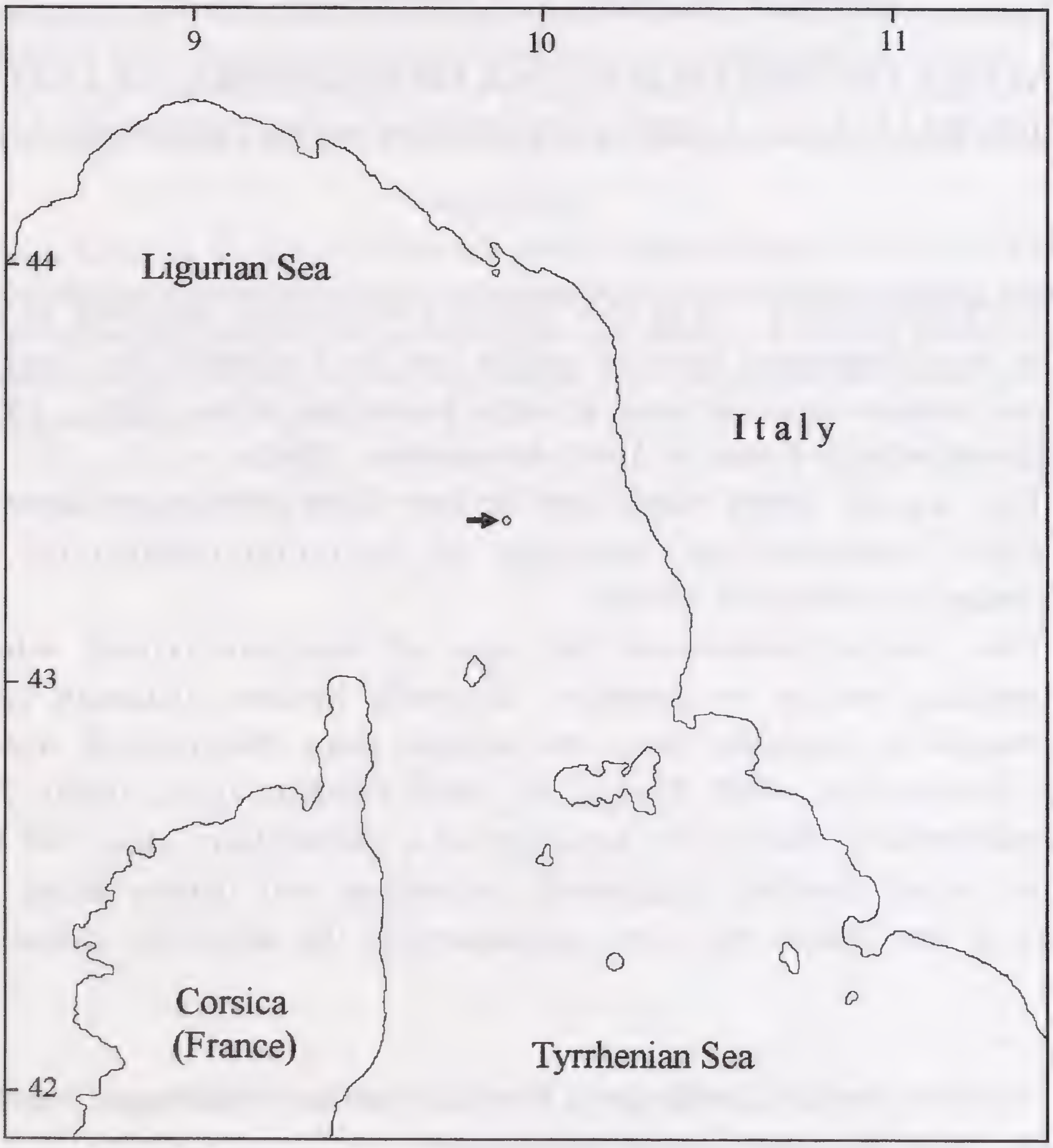

Fig. 1 - Map showing the geographical location of the sampling area.

MATERIAL AND METHODS – *Study area*: this study was carried out off the Gorgona Island, the northernmost of the Tuscan Archipelago (Fig. 1), which extends over about 2.2 Km^2.

A total of 9 diurnal and 4 nocturnal visual censuses were performed in September 1989 along transects placed in different sites of the Island: Costa dei Cantoni (4 diurnal censuses) on the western coast, Cala Marcona (2+2 censuses) and Cala Scirocco (3+2 censuses), on the north-eastern and southern coasts, respectively (Fig. 2).

The first site was characterized, between 10 and 14 m depth, by a heterogeneous rocky bottom interspersed with isolated shoots of the seagrass *Posidonia oceanica* (L.) Delile. At Cala Marcona, the observations were carried out between 9 and 12 m depth on a slope covered by a homogeneous *Posidonia oceanica* bed. At Cala Scirocco, censuses were carried out between 13 and 17 m depth on a discontinuous meadow with rocky substratum scattered. In addition, a total of 13 random courses were performed at Cala Maestra, Costa dei Cantoni, Punta Scirocco, Cala Marcona and Cala Martina (Fig. 2).

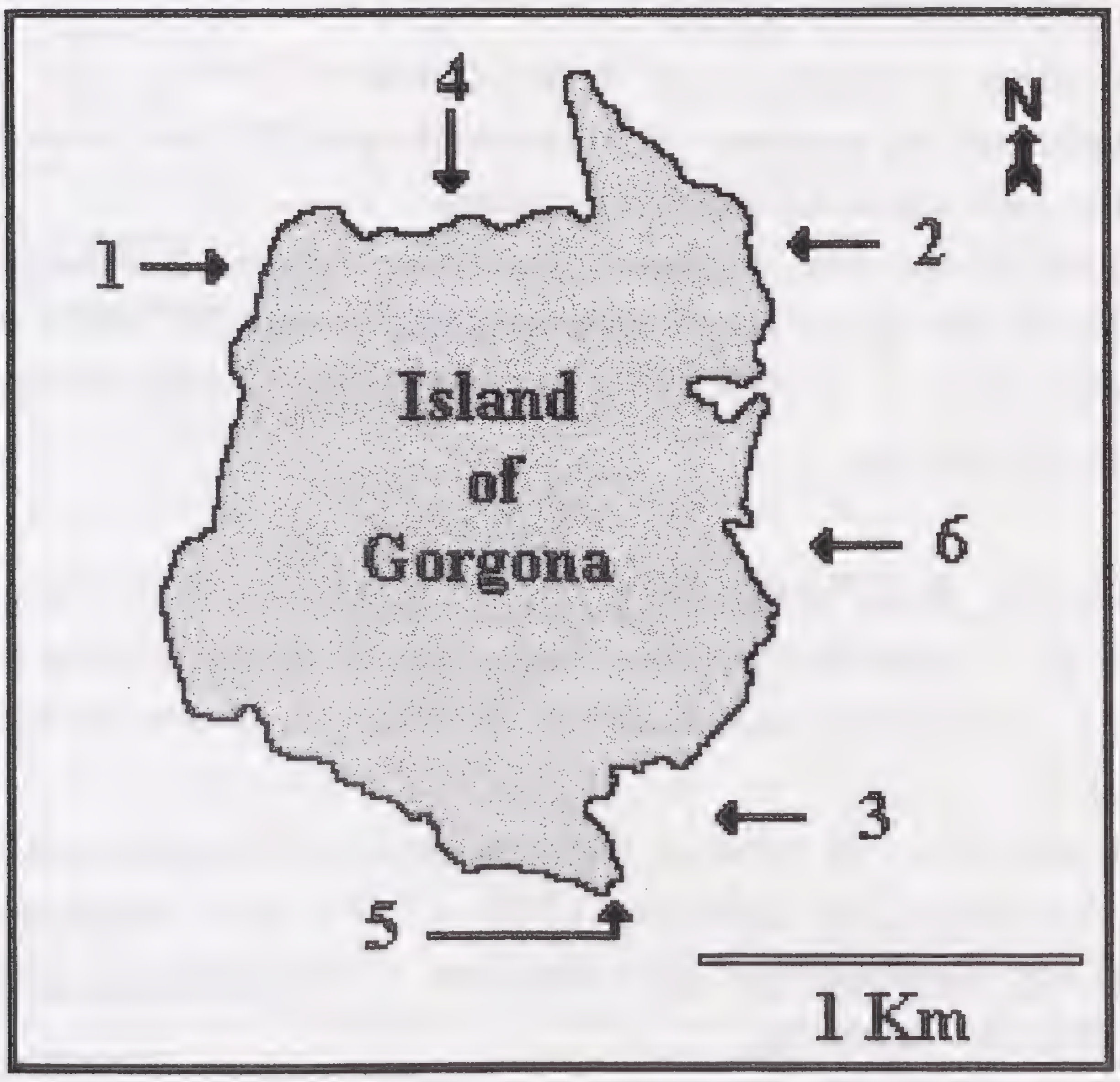

Fig. 2 - Sampling sites: 1) Costa dei Cantoni; 2) Cala Marcona; 3) Cala Scirocco; 4) Cala Maestra; 5) Punta Scirocco; 6) Cala Martina.

Sampling technique: visual censuses were conducted by SCUBA diving and snorkelling using different underwater visual techniques:

1) diurnal strip-transects;

2) nocturnal strip-transects;

3) random courses by SCUBA diving and snorkelling.

As far as the strip-stransect technique is concerned, as described by HARMELIN-VIVIEN *et al.* (1985), fishes were counted on a standardized area of 250 m^2 along a 50 m long and 5 m wide strip-stransect at depths ranging from 9 to 17 m. As regards the diurnal transects only, data were collected daytime from 9.00 a.m. and 6.45 p.m. hours in order to avoid estimated affected by nycthemeral variations (HARMELIN-VIVIEN *et al.*, 1985).

Qualitative data were collected by "random courses" (HARMELIN-VIVIEN *et al.*, 1985) performed between 0 and 32 m depth during the day-light hours.

Each censused specimen was classified as small, medium, large and very large according to the maximum recorded total length of each species (FISCHER *et al.*, 1987) and abundance data were recorded by a geometrical progression with a base 2 (1, 2-5, 6-10, 11-30, 31-50, 51-100, 101-200, 201-500, >500).

According to BOHNSACK & BANNEROT (1986), the density of fishes, expressed as number of individuals per 250 m^2, was considered as an index and no as an absolute datum.

Because of the low number of transects at each counting station, the data from the three sites were pooled, being the main aim of this study to provide a preliminary description of the features of the Gorgona's fish fauna.

RESULTS AND DISCUSSION — A total of 40 fish species belonging to 17 families were recorded by the combination of the three techniques employed (nocturnal and diurnal transects, random courses; Tab. I and II).

From the point of view of the species number, the community was strongly dominated by Labridae (30% of the total number of species censused) and Sparidae (22.5%) families, contributing to about 50% of the total species richness.

Besides, the fish assemblage showed a marked variation depending on the nycthemeral cycle. A low number of species, in fact, was recorded in the nocturnal censuses (25 vs 12). Moreover, by diurnal strip-transects were encountered a mean number of species as 11.0 ±

3.35 and 169.67 ± 107.35 individuals/250 m^2, while by nocturnal transects were censused 6.25 ± 2.06 species and 21.25 ± 11.86 individuals/250 m^2.

		Diurnal census						Nocturnal census				
Families	**Species**	**A(3)**	**B(4)**	**C(2)**	**N**	**SD**	**fr**	**A(2)**	**C(2)**	**N**	**SD**	**fr**
Apogonidae	*Apogon imberbis* (L.)	x	x	x	1.06	1.81	44					
Atherinidae								x		1.12	1.65	50
Blenniidae			x		0.22	0.66	11	x	x	3.62	2.56	75
Centracanthidae	*Spicara maena* (L.)		x		0.4	1.16	11	x	x	10	6.28	100
Gobiidae									x	0.25	0.5	25
Labridae	*Coris julis* (L.)	x	x	x	18.56	7.4	100					
	Labrus merula L.	x	x		0.44	0.73	33					
	Symphodus cinereus (Bonn.)			x	0.72	1.82	22					
	Symphodus mediterraneus (L.)	x		x	0.78	1.56	22					
	Symphodus melanocercus (Risso)	x	x	x	1.28	1.79	56					
	Symphodus ocellatus (Forssk.)	x	x	x	6.11	10.9	44					
	Symphodus roissali (Risso)		x	x	1.0	1.95	22					
	Symphodus rostratus (Bloch)	x	x	x	0.78	0.83	56					
	Symphodus tinca (L.)	x		x	1.0	2.05	22	x		0.25	0.5	25
	Symphodus sp.	x	x		0.22	0.44	22					
Mullidae	*Mullus surmuletus* L.	x	x	x	1.72	1.86	89					
Pomacentridae	*Chromis chromis* (L.)	x	x	x	115.7	114.3	100	x	x	2.0	1.83	75
Scorpaenidae	*Scorpaena notata* Raf.							x	x	1.75	1.26	50
	Scorpaena porcus L.	x			0.11	0.33	11					
	Scorpaena scrofa L.								x	0.25	0.5	25
Serranidae	*Serranus cabrilla* (L.)	x	x	x	4.5	3.4	100	x	x	1.5	1.5	50
	Serranus scriba (L.)	x	x	x	3.28	2.26	89	x	x	0.25	0.5	50
Sparidae	*Diplodus annularis* (L.)	x	x		0.89	1.52	33	x	x	0.75	0.5	75
	Diplodus sargus (L.)	x		x	0.5	1.17	22					
	Diplodus vulgaris (E. Geoffr.)		x	x	0.55	1.0	33					
	Oblada melanura (L.)	x		x	0.5	1.17	22					
	Sarpa salpa (L.)			x	6.78	14.4	22					
	Spondyliosoma cantharus (L.)	x	x	x	3.94	4.03	89		x	0.25	0.5	25
Tripterygiidae	*Tripterygion* sp.		x	x	0.44	0.88	22					

Tab. I - Fish species censused in the three "strip transects" by SCUBA diving visual methods; A=Punta Scirocco; B=Costa Cantoni; C=Cala Marcona; N=mean number; SD=standard deviation; fr=frequency of occurrence (%).

Families	**Species**	**fr**	**S**	**M**	**L**	**VL**
Apogonidae	*Apogon imberbis* (L.)	30.7	x		x	
Blenniidae	*Parablennius sanguinolentus* (Pallas)	7.6			x	
Carangidae	*Seriola dumerilii* (Risso)	15.3	x		x	
Centracanthidae	*Spicara maena* (L.)	53.8			x	
	Spicara smaris (L.)	7.6			x	
Congridae	*Conger conger* (L.)	7.6		x		
Labridae	*Coris julis* (L.)	76.9	x	x	x	x
	Labrus bimaculatus L.	7.6			x	
	Labrus merula L.	46.1	x	x	x	x
	Labrus viridis L.	7.6		x		
	Symphodus cinereus (Bonn.)	15.3		x		
	Symphodus doderleini Jordan	7.6		x		
	Symphodus mediterraneus (L.)	30.7		x	x	
	Symphodus melanocercus (Risso)	30.7		x	x	
	Symphodus ocellatus (Forssk.)	30.7	x	x	x	
	Symphodus roissali (Risso)	23	x	x	x	
	Symphodus rostratus (Bloch)	30.7		x	x	
	Symphodus tinca (L.)	46.1	x	x	x	
Mugilidae	*Mugil* sp.	7.6	x	x		
Mullidae	*Mullus surmuletus* L.	53.8	x	x	x	
Muraenidae	*Muraena helena* L.	30.7		x	x	x
Pomacentridae	*Chromis chromis* (L.)	69.2	x	x	x	
Sciaenidae	*Sciaena umbra* L.	38.4			x	
Scorpaenidae	*Scorpaena porcus* L.	7.6		x		
	Scorpaena scrofa L.	15.3			x	x
Serranidae	*Epinephelus marginatus* (Lowe)	61.5				x
	Serranus cabrilla (L.)	46.1	x	x	x	x
	Serranus scriba (L.)	7.6		x	x	x

(*segue*)

Families	Species	fr	S	M	L	VL
Sparidae	*Boops boops* (L.)	38.4		x	x	
	Dentex dentex (L.)	23			x	x
	Diplodus annularis (L.)	23		x	x	
	Diplodus puntazzo (Cetti)	7.6			x	
	Diplodus sargus (L.)	38.4	x	x	x	x
	Diplodus vulgaris (E. Geoffr.)	38.4	x		x	x
	Oblada melanura (L.)	38.4	x	x	x	
	Sarpa salpa (L.)	38.4	x	x	x	
	Spondyliosoma cantharus (L.)	61.5	x	x		
Tripterygiidae	*Tripterygion* sp.	7.6	x		x	

Tab. II - Fish species censused by visual methods (13 "random courses"). fr=frequency of occurrence (%); size-class categories: S=small; M=medium; L=large; VL=very large.

This does not agree with the results obtained by HARMELIN-VIVIEN (1982) in the National Park of Port-Cros. This author observed an increased number of species and diversity at night than during the day, but this difference could be justified with the completely different method of sampling.

In our case, we employed visual census techniques, which show obvious difficulties and limitations by night, while HARMELIN-VIVIEN (1982) utilized a small skid trawl, whose advantages and limitations in comparison with the visual counts were discussed in HARMELIN-VIVIEN & FRANCOUR (1992).

In any case, the diel variation in the fish community structure is related to the activity rhythm and feeding behaviour of each species.

In the same way, an obvious discrepancy is evident with the species list concerning fish species obtained by VINCIGUERRA (1926) at the Island of Giglio (Tuscan Archipelago); this author censused, for example, 4 species of the genus Crenilabrus (Symphodus actually), 10 Blennius (actually subdivided in several genus) and, in general, a longer list species than that presented in this paper. However, sampling methods employed by VINCIGUERRA (1926) resulted completely different and fundamentally based on the direct sampling (nets and angling).

As regards the random courses method, 38 species were found (Tab. II).

The results obtained pointed out the efficiency of this method when the objective is to characterize qualitatively fish assemblages. In fact, it has be emphasized that, utilizing this technique, very large groups of *Dentex dentex* and *Seriola dumerili* were recorded together with a conspicuous number of specimens of *Sciaena umbra*, which is a species of very important economic interest.

Besides, it is worth to note the very high number of species showing specimens characterized by large and very large sizes. A lot of these are indicated ad "target species" for many kinds of professional or recreational fisheries, such as *Seriola dumerili*, *Mullus surmuletus*, *Sciaena umbra*, *Scorpaena scrofa*, *Serranus cabrilla*, *S. scriba*, *Epinephelus marginatus*, *Coris julis*, *Labrus merula* and all the species belonging to the Sparidae family, *Spondyliosoma cantharus* excepted (GARCIA-RUBIES & ZABALA, 1990; HARMELIN *et al.*, 1995).

The richness and size structure of the fish fauna observed at Gorgona emphasize the extremely important effects of the protection measures on the marine areas stressing the necessity of the establishment of marine parks against the risk of decreasing diversity and marine resources determined by human activities in other areas of the Mediterranean Sea.

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ABSTRACT

The fish assemblages of Gorgona Island were studied by visual census methods during September 1989 in six different sites at depths ranging from 0 to 32 m.

The community was composed by 40 species belonging to 17 families and dominated, from the point of view of the species number, by Labridae (12 species corresponding to 30% of the total number of species censused) and Sparidae (9 species: 22.5%).

The diurnal assemblage resulted richer in species than the nocturnal one, in relation to the different behaviour characterizing each species.

The high number of species showing large and very large individuals, mainly belonging to target species for commercial and amatorial fishing, emphazises the positive effects played by severe measures of protection determined, in the case of Gorgona, by the presence of a penitentiary since the last century.

RIASSUNTO

Nel presente lavoro vengono riportati i dati relativi alla fauna ittica dell'isola di Gorgona raccolti nel Settembre 1989. I campionamenti sono stati effettuati tramite censimenti visuali in immersione in sei diversi siti ed a profondità comprese tra 0 e 32 m.

Sono state censite in totale 40 specie ittiche appartenenti a 17 famiglie; nella

comunità studiata sono risultate dominanti, in termini di numero di specie, le famiglie Labridae (con 12 specie corrispondenti al 30% del numero totale di specie censite) e Sparidae (con 9 specie pari al 22.5%).

I censimenti diurni hanno consentito di campionare un numero maggiore di specie rispetto a quelli notturni, in relazione alle abitudini nictemerali di ciascuna specie.

L'elevata presenza di esemplari di taglia grande e molto grande appartenenti a specie ittiche di primaria importanza sottolinea gli effetti positivi derivanti da misure di protezione in aree marine, situazione determinata, nel caso di Gorgona, dalla presenza di un penitenziario fin dal secolo scorso.